Arbitration and Renegotiation in Trade Agreements

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What can parties to a trade agreement achieve by institutionalizing a rules-based dispute settlement procedure? What role can third-party arbitration play in dispute settlement? I study these questions within a mechanism design framework. The model generates predictions regarding the pattern of pre-trial and post-trial settlement negotiations, non-compliance with the arbitrator's ruling, and retaliations under an optimal trade agreement. It is shown that an Arbitrated-Liability Regime, under which a defecting party is liable for damages only to the extent that an arbitrator specifies, could implement the optimal direct mechanism. Moreover, property rule is not an optimal "escape" provision as it induces too much retaliations. (*JEL* F13, K33)

1. Introduction

A remarkable achievement of the GATT/WTO negotiations has been the institutionalization of procedures to resolve disputes in implementation of trade agreements. Over time, dispute settlement among trading partners has evolved from a mostly informal bargaining process, with little restriction on acceptable norms of negotiation, to a rules-based process, with elaborate principles and rules for resolving disputes. This evolution toward a rules-based system culminated in the Dispute Settlement Understanding (DSU) of the WTO, which specifies rules of negotiation and includes provisions for third-party arbitration.

Both the WTO and its predecessor, GATT, include an escape clause or safeguard agreement, which allows signatories to withdraw or modify trade policy concessions in response to unforeseen developments that cause or threaten serious injury to domestic producers. In the Law and Economics literature, the liability rule and the property rule specify

different remedies for breach of a legal right. In the context of the WTO, the tariff commitments may be interpreted as conferring a legal right to low tariffs for exporting countries. However, the escape clause makes these rights effectively contingent on the state of the world, which may open the door to disputes in the implementation of the trade agreement if these contingencies are not easily verifiable.

The objective of this article is two-fold. The first objective is to provide a model of the WTO's legal structure to analyze the pattern of dispute settlement and arbitration in the WTO. To this end, I interpret the legal structure of the WTO as an Arbitrated-Liability Regime (ALR), under which a party that has deviated from its obligations is *liable* for the resulting damages only to the extent that is determined by the arbitrator.[1] This interpretation is consistent with contingent protection provisions such as the WTO agreements on safeguards and antidumping measures. The Agreement on Safeguards, for example, stipulates contingencies under which a member country is entitled to violating its tariff commitments to a certain degree without being liable for the damages that it causes to the exporting countries. A safeguard-imposing country will be held liable only if it applies protection beyond what is authorized by the WTO Dispute Settlement Body (DSB). The magnitude of liability, which usually translates to retaliatory measures from exporting countries, is also determined by DSB arbitration based on remedy principles that are specified in the agreement.

Under this model, noncompliance with DSB rulings is an equilibrium outcome. This finding resonates with the empirical facts about noncompliance with the WTO rulings. In practice, in about one out of every five cases for which the DSB has issued a final ruling, the defending governments allegedly failed to bring their actions in compliance with the DSB recommendations immediately (Wilson 2007).[2,3]

My second objective is to analyze the "optimality" of the ALR, which was discussed above. To this end, I will set a benchmark by taking a mechanism-design approach that is not restricted by the existing rules in the WTO. I will characterize the direct-revelation mechanism that

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1. Liability Rule is a term that is used in the Law and Economics literature to describe a legal principle under which a contracting party who wishes to *escape* from its obligations is allowed to do so, but it will be also liable for damages that the defection inflicts on the other contracting parties. This principle is usually compared with the Property Rule, under which violation of the contract is allowed only by consent of all the contracting parties.

2. Examples of non-compliance with the WTO rulings include the Hormones dispute between the European Communities (as defendant) and the United States and Canada (as complainants), in which the European Communities declined to comply with the DSB's ruling to lift a ban on importation of beef products from United States and Canada (WTO 1999). Another example is provided by the Canada-Dairy dispute, in which case the DSB's ruling against Canada was followed by a long period of negotiation between disputing parties. After more than three years of negotiations, the parties achieved a mutually accepted solution that was different from the original ruling of the DSB (WTO 2003).

3. For empirical analyses of the WTO Dispute Settlement Process see Busch and Reinhardt (2002), Bown (2004, 2005), and Beshkar and Majbouri (forthcoming).

maximizes the expected joint-welfare of the governments under the assumption that the parties could renegotiate the outcome of the mechanism ex post. The resulting mechanism is an abstract creation with limited resemblance to the real-world institutions. I will then show that the optimal ALR, which resembles the general structure of the WTO agreement, is able to replicate the performance of the optimal direct mechanism (DM); that is, it implements the same outcome.

This article provides a framework to evaluate two canonical legal principles for breach remedies, namely, the Property Rule and the Liability Rule. Under the Property Rule, both parties' consent is required to alter the status quo policies that are specified by the arbitrator. In other words, the Property Rule leaves renegotiations unrestricted and parties will follow their informal norms to choose an outcome. In contrast, under the liability rule a defending party (here the breaching importing country) may deviate unilaterally from the arbitrator's recommended outcome as long as the complaining party (here the affected exporting country) is compensated according to a prespecified schedule. Therefore, in contrast to the Property Rule, renegotiation is structured by a prespecified retaliation scheme under the Liability Rule.

It is shown that the Property Rule is not an optimal *escape* provision. Under this rule the exporting country's consent is necessary for escape, which implies that the exporting country would be over-compensated, or at least fully compensated, for the breach of the agreement. But since compensation takes an inefficient form in trade relationships, it is optimal for an agreement to induce the minimum level of compensation that is necessary to prevent inefficient breach. Moreover, it is shown that the magnitude of compensation or retaliation that is necessary to ensure incentive compatibility does not fully compensate the loss of the affected exporting countries. Hence, the Property Rule is suboptimal as an escape provision since it induces too much retaliation in the equilibrium.

This article also sheds light on the apparent bias in the DSB rulings. As discussed by Sykes (2003), Grossman and Sykes (2007), and Colares (2009), in a strong majority of the cases the DSB rules at least partly against the defending party. The model suggests that this ruling pattern may be part of the optimal design of the system. In particular, even if the DSB's assessment of the disputed measure is in favor of the defending party, it is optimal for the DSB to authorize only a small deviation from the agreement tariff.

In a parallel research, Maggi and Staiger (2015b) have developed a model of the DSB that generates pre-arbitration settlement and post-arbitration renegotiation. In contrast to the current paper, Maggi and Staiger (2015b) assume that parties have symmetric information about the state of the world although this information is not verifiable to the court. Moreover, while I study continuous policies, Maggi and Staiger

(2015b) focus on disputes about trade policies that are discrete (binary) in nature.[4]

Park (2011), Maggi and Staiger (2011), Beshkar (2010b), and Klimenko et al. (2007) are among recent papers that provide formal models of the DSB.[5] These models investigate alternative roles that an international tribunal like the DSB can play. As in this article, Beshkar (2010b) and Park (2011) show the benefit of introducing arbitration into the WTO agreement by modeling the WTO as a signaling device. However, these papers do not characterize the optimal agreement and do not allow for pre-arbitration settlement bargaining or ex post renegotiation. The focus of Maggi and Staiger (2011) is on the role of arbitration when writing a complete contract is costly. Third-party arbitration, in their model, could improve cooperation by filling the gap in the contract under contingencies that are not specified in the agreement. Within a repeated-game framework, Klimenko et al. (2007) show that the DSB could facilitate cooperation by defining the way in which negotiation between countries is conditioned on the current state of the world and the history of their policy interaction. Finally, Beshkar (2010a) takes a mechanism-design approach as in this article but does not include the possibility of arbitration or renegotiation.

In Section 2, I introduce the basics of the model, including the political-economy framework of the article and the role of the DSB. In Section 3, I introduce a formal model of the ALR and discuss the relevance of this regime to the actual WTO agreement. Models of renegotiation in the interim and ex post stages are introduced in Section 4. Then, in Section 5, I set a benchmark for the rest of the article by characterizing the optimal DM given the possibility of renegotiation. In Section 6, I show that the ALR could implement the outcome of the optimal DM. In Section 7, I study further implications of the optimal mechanism. Section 8 contains concluding remarks and suggestions for future research.

2. Basic Setting

I work within a simple political-economy trade framework that is used frequently in the literature.[6] This framework is based on competitive markets with linear demand and supply functions in which countries gain from trade due to different production costs. The trade policy instrument at the

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4. Maggi and Staiger (2015a) also study optimal trade agreements at the presence of renegotiations for the case where no informative arbitrator exists. I will discuss the relationship between my results and that of Maggi and Staiger (2015a, 2015b) in Section 7.3.1 and several other points throughout the article.

5. Earlier models of the WTO dispute settlement process include Reinhardt (2001), Ludema (2001), and Rosendorff (2005). For a survey of these papers see Beshkar (2010b).

6. See, for example, Bagwell and Staiger (2005) and Beshkar (2010b).

governments' disposal is import tariffs. The details of this framework are laid out in Appendix A.

To focus on the problem of dispute resolution between two trading partners, I assume that there are two countries, a potential Defendant, denoted by D, and a potential Complainant, denoted by C. I will use τ^D and τ^C to denote the specific import tariffs of D and C, respectively. Each government maximizes a weighted sum of its producers' surplus (π), consumers' surplus (ψ), and tariff revenues (R), with a potentially higher weight on the surplus of its import-competing sector.[7] Denoting the political weight on the welfare of the import-competing sector by $\theta \geqslant 1$,[8] D's welfare drawn from its importable sector, m, is given by

$$u^D(\tau^D; \theta) \equiv \psi_m(\tau^D) + \theta\pi_m(\tau^D) + R(\tau^D).$$

Moreover, D's welfare from its exportable sector, x, is given by

$$v^D(\tau^C) \equiv \psi_x(\tau^C) + \pi_x(\tau^C).$$

The payoffs of C may be defined in a similar fashion.

A simple way to model a dispute in this framework is to assume that the political-economy parameter of the potential defendant, D, is subject to privately observed shocks. Since θ is not publicly observable, an upward adjustment in import tariffs as a response to an alleged increase in θ may cause disagreement between the parties.

To capture the uncertainty in the future political-economy preferences, I assume that D's political-economy parameter, θ, is drawn from a binary set $\{l, h\}$, $h > l \geqslant 1$, such that $\theta = h$ with probability ρ and $\theta = l$ with probability $1 - \rho$.[9] I use D_θ to refer to D of type θ.

For simplicity, I assume that C's political-economy parameter is constant and equal to l.[10] Thus, letting $t \equiv (\tau^D, \tau^C)$, I use $V^C(t) \equiv u^C(\tau^C; l) + v^C(\tau^D)$ and $V^D(t; \theta) \equiv u^D(\tau^D; \theta) + v^D(\tau^C)$ to denote the payoffs of C and D, respectively. Then the joint welfare of the governments may be written as

$$W(t; \theta) \equiv V^D(t; \theta) + V^C(t).$$

The non-cooperative tariff of D, denoted by $\tau_N^D(\theta)$, is one that maximizes

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7. The higher weight given to the welfare of a sector may be the result of political pressure, through lobbying for example, that a government faces.

8. In referring to θ, I will use "states of the world", "political-economy pressure", and "political-economy parameter" interchangeably.

9. I will assume that $h - l$ is positive but sufficiently small such that $\tau^N(l) \geqslant \tau^E(h)$. This assumption simplifies the analysis by eliminating the possibility of tariff binding overhang under an optimal agreement. For models of tariff overhang see Amador and Bagwell (2013), Beshkar et al. (2015), and Beshkar and Bond (2015).

10. In practice, trade agreements are over multiple sectors, each of which may have a different political economy parameter. Moreover, these political economy parameters could be correlated across sectors and countries. However, as an initial attempt at modeling trade agreements in the presence of arbitration and renegotiations, I abstract from such possibilities by focusing on a single sector with uncertain political economy conditions.

$u^D(\tau^D; \theta)$. The cooperative tariff of the D, denoted by $\tau_E^D(\theta)$, is defined as the tariff that maximizes the joint payoffs of the governments from D's import tariff, that is, $u^D(\tau^D; \theta) + v^C(\tau^D)$. Due to the terms-of-trade externality, the non-cooperative tariff is greater than the cooperative tariff, that is, $\tau_N^D(\theta) > \tau_E^D(\theta)$, as long as these tariffs are non-prohibitive. Nash and efficient tariffs of C, that is, τ_N^C and τ_E^C, may be defined in a similar fashion. The tariff pairs that maximize the joint welfare of the governments will be denoted by $t_E(l) \equiv \left(\tau_E^D(l), \tau_E^C \right)$ and $t_E(h) \equiv \left(\tau_E^D(h), \tau_E^C \right)$. Finally, T denotes the set of tariff pairs, and $P_l, P_h \subset T$ denote the set of Pareto efficient tariff pairs under low and high political pressures, respectively.

I assume that tariffs are "*public actions*", which are externally enforceable. In Watson's (2007) terminology, a public action is one taken by an external enforcement entity, while an individual action is one that could be taken only by one of the contracting parties. It is common in the mechanism design literature to assume that all verifiable actions are public actions. However, Watson (2007) shows that this assumption may exclude some value functions that are otherwise implementable. Watson's results are obtained for an environment in which (i) trade actions are inalienable and irreversible, (ii) parties have ex post renegotiation opportunities, and (iii) renegotiation takes place in a setting of complete information. Tariff actions inherently have an irreversible component (parties have to wait until the next period to change them) and so the model here may underestimate the set of implementable value functions. However, I consider a setting with incomplete information, which goes beyond Watson's analysis and is simplified by the use of a public-action model.[11]

As in Beshkar (2010b) and Park (2011), I assume that the DSB is an impartial entity that receives a noisy signal, denoted by θ_A, about the state of the world in the defending country. I assume that this signal matches the true state of the world, that is, $\theta_A = \theta$, with probability $\gamma > \frac{1}{2}$, namely:

$$Pr(\theta_A = l | \theta = l) = Pr(\theta_A = h | \theta = h) = \gamma.$$

Assuming that the DSB has an informational role is broadly consistent with its mandate to make "objective assessment of the facts" of the dispute case and to make "recommendations" to help the disputing parties to develop a mutually satisfactory solution (WTO, 1995a). Through objective assessment of the facts, the DSB can obtain a signal, albeit imperfect, about the underlying political-economy conditions in the defending country. The recommendation of the DSB for a settlement, therefore, reflects the information that the DSB has obtained through its objective assessment.[12]

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11. More discussion of Watson's critique is provided in the conclusion.

12. It is worth noting that assuming an informational role for the DSB does not imply any informational advantage on behalf of the DSB over the disputing parties. The advantage of the DSB over the disputing parties is its "impartiality", which makes its public announcements about its privately observed signal reliable.

3. Arbitrated-Liability Regime

Under a liability-rule system, a contracting party who wishes to *escape* from its obligations is allowed to do so but it will be liable for resulting damages. As is well known in the law and economics literature, an escape clause could improve the efficiency of a contractual relationship by encouraging *efficient breach* of the agreement, such that a contract is not performed under contingencies where the cost of performance exceeds its social benefits.[13]

In a similar fashion, the WTO members have reserved the right to increase their tariffs above their tariff binding commitments under certain conditions. As stated in Article 2 of the Agreement on Safeguards, a member country may apply a safeguard measure to a product only if a surge in imports *"cause or threaten to cause serious injury to the domestic industry."* In practice, a safeguard measure is adopted by a government if the interested industries successfully lobby the government to take such actions. Through this process, the lobby groups are supposed to produce evidence regarding the extremely adverse impact of trade liberalization on their industries, which then may be used by the government to justify an escape from the agreement. Given the political-economy nature of this process, the safeguard provision may be interpreted as a safety valve for governments to diffuse political-economy pressures.[14]

According to the WTO agreement, the safeguard-imposing country has to exercise restraint in choosing the level of protection. Moreover, the affected countries may be entitled to some form of compensation. The WTO's Agreement on Safeguards (WTO 1995b) states that

> A Member shall apply safeguard measures only to the extent necessary . . . . The affected exporting Members shall be free. . . to suspend. . . the application of substantially equivalent concessions. [However,] the right of suspension. . . shall not be exercised. . ., provided that the safeguard measure. . . conforms to the provisions of this Agreement.

The method of compensation that is envisioned in this statement is suspension of concessions, namely, retaliations, by the affected countries. Moreover, according to this clause, retaliations must be limited to withdrawal of substantially equivalent concessions.

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13. As suggested by (Sykes 1991: 284) and discussed below, an interesting analogy may be drawn between the liability regime and the WTO's system of remedies. I extend his view by noting that under the WTO, the extent of liability depends on the prevailing contingency, which may be determined through third-party arbitration.

14. Viewing safeguards as a means of diffusing political-economy pressures is a standard assumption in the literature. For further discussion of this point see Sykes (2006), Baldwin and Robert-Nicoud (2007). Section 2 of Beshkar (2010b) provides a summary.

I will also assume that tariff retaliations are the only compensation mechanism that is available at the time of implementing the agreement.[15] However, instead of trying to quantify the level of substantially equivalent concessions, I will solve for the optimal level of retaliations.

If the parties cannot agree on the size of necessary protection or the magnitude of retaliations, the WTO's DSB may be called for arbitration. We may interpret this system as an ALR, since a defector is liable only to the extent that is determined by the arbitrator.

I will study the problem of designing a trade agreement as a mechanism design problem. The general class of mechanism that I study is characterized by a message sent by D followed by a signal received by the Arbitrator, henceforth denoted by A. Then A compels tariffs for both countries as a function of the messages and the signal. The ALR mechanism, which is a special case of this general mechanism, is described next.

In order to build a formal model of the ALR, let t_b denote the negotiated tariff pair, which is supposed to be implemented in the normal times. Moreover, let t_s denote the tariff pair that is supposed to be implemented under the contingency in which a safeguard measure is justifiable. The ALR may be formally defined as follows:

Definition 1. An ALR is a trade agreement that is characterized by:

A *tariff binding,* pair, $t_b \equiv (\tau_b^D, \tau_b^C)$, which determines the maximum tariff that each country is allowed to choose when political-economy pressures are low.

A *safeguard tariff* pair, $t_s \equiv (\tau_s^D, \tau_s^C)$, such that $\tau_s^D > \tau_b^D$ and $\tau_s^C = \tau_b^C$. τ_s^D is the maximum tariff that the importing country (i.e., Defendant) is allowed to choose when political-economy pressures are high, without facing retaliations ($\tau_s^C = \tau_b^C$).

An *arbitrator* who, in case of a disagreement between parties, will authorize escape if and only if $\theta_A = h$. Equivalently, the arbitrator recommends the tariff pair $t_A(\theta_A)$, such that $t_A(l) = t_b$ and $t_A(h) = t_s$.

A *retaliation scheme*, $r_{\theta_A}(\tau^D)$, which determines the magnitude of acceptable retaliation by C. In other words, C is restricted to $\tau^C \leqslant r_{\theta_A}(\tau^D)$. The time-line of the ALR is shown in Figure 1. After observing its type, D could either apply $\tau^D \leqslant \tau_b^D$ or invoke the *escape clause* at Date 2. The choice between applying $\tau^D \leqslant \tau_b^D$ and the invocation of the escape clause may be interpreted as a message from D in the mechanism design problem. If the escape clause is invoked, the game proceeds to arbitration (Date 3). The arbitrator first draws a signal, θ_A, at Date 3-1 and then authorizes the escape if and only if it receives a high signal, $\theta_A = h$. If escape is authorized, D's tariff binding increases from τ_b^D to τ_s^D. This implies that C's tariff

Date

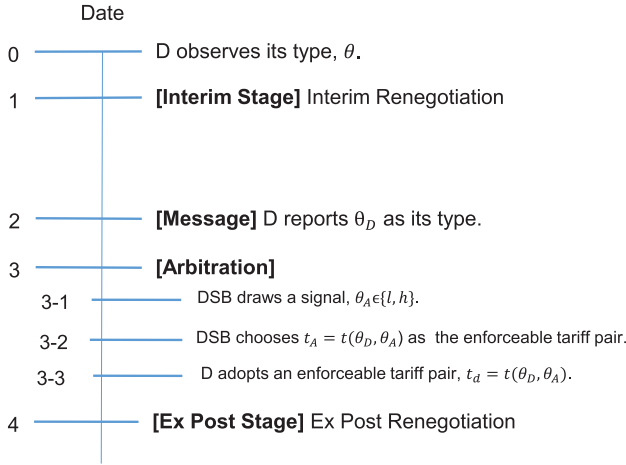|		
0		D observes its type, θ.
1		**[Interim Stage]** Interim Renegotiation
2		**[Message]** D reports θ_D as its type.
3		**[Arbitration]**
	3-1	DSB draws a signal, $\theta_A \in \{l, h\}$.
	3-2	DSB chooses $t_A = t(\theta_D, \theta_A)$ as the enforceable tariff pair.
	3-3	D adopts an enforceable tariff pair, $t_d = t(\theta_D, \theta_A)$.
4		**[Ex Post Stage]** Ex Post Renegotiation

Figure 1. Timeline of the Arbitrated-Liability Regime (ALR).

is bound at its baseline, τ_b^C, unless retaliations are authorized. In other words, at Date 3-2 the arbitrator recommends $t_A(\theta_A) : \{l, h\} \rightarrow \{t_b, t_s\}$, and specifies the retaliation menu, $r_{\theta_A}(\tau^D)$, such that

$$t_A(l) = t_b, \, t_A(h) = t_s,$$

$$\tau^D > \tau_A^D(\theta_A) \Leftrightarrow r_{\theta_A}(\tau^D) > \tau_b^C,$$

$$r_l(\tau_b^D) = r_h(\tau_s^D) = \tau_b^C.$$

The last set of equalities indicates that the arbitrator authorizes retaliations only if D applies a tariff in excess of the recommended level, that is, if $\tau^D > \tau_A^D(\theta_A)$. Therefore, the retaliation menus will satisfy $r_l(\tau_b^D) = r_h(\tau_s^D) = \tau_b^C$.

In order to examine the optimality of the ALR, I first take a more general approach by finding the optimal DM under the same environment (Section 5). In principle, the optimal DM could result in a higher welfare than ALR. Nevertheless, as I show in Section 6, the ALR could in fact implement the outcome of the optimal DM.

A central assumption of the article is that the trading partners could renegotiate the terms of the agreement both at the interim stage (Date 1) and the ex post stage (Date 4). The outcome of any mechanism, therefore, depends on the details of the bargaining procedures for each of these stages, which are laid out in the next section.

4. Renegotiation

I consider two renegotiation possibilities: interim renegotiation (Date 1), which takes place after the realization of private information and before
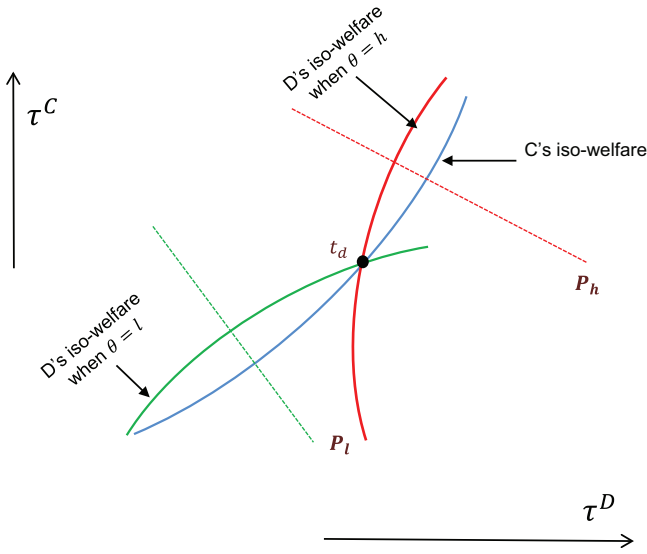
Figure 2. Pareto Improvement Possibilities for a Given Tariff Pair, t_d, When $\theta = l, h$.

sending messages, and ex post renegotiation (Date 4), which takes place after the outcome of the mechanism is determined.[16] Both of these renegotiation opportunities take place under imperfect information.[17] In this section, I will discuss the bargaining models that I use for each of these renegotiation possibilities.

4.1 Ex Post Renegotiation

Suppose that countries C and D are currently implementing an externally enforceable tariff pair, t_d, as depicted in Figure 2. In this figure, P_l and P_h depict the set of Pareto efficient tariff pairs when $\theta = l$ and $\theta = h$, respectively. The disagreement tariff pair, t_d, could be thought of as the outcome of a mechanism, which is enforceable by assumption.

I assume that at the ex post stage the complaining country could offer a menu of tariff pairs, M, to the defending country as an alternative to t_d. The defending country could then implement t_d or any tariff on the proposed menu.

To elaborate, let $\Upsilon^{\theta} : T \rightarrow P_{\theta}$ be a mapping such that

$$V^D\left(\Upsilon^{\theta}(t_d); \theta\right) = V^D(t_d; \theta). \tag{1}$$

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16. These are two renegotiation possibilities that are usually considered in the mechanism design literature (Neeman and Pavlov 2013).

17. Other papers in the literature, including Maggi and Staiger (2015a, 2015b), study renegotiations under perfect information and use the Nash Bargaining Solution to model bargaining.

In other words, $\Upsilon^\theta(t_d)$ is defined as a Pareto efficient tariff pair given θ, which makes D_θ indifferent between implementing $\Upsilon^\theta(t_d)$ and t_d. Moreover, let $T^* \subset T$ be the set of all tariff pairs, t, such that

$$\Upsilon^h(t) \overset{D_l}{\leqslant} \Upsilon^l(t), \tag{2}$$

$$\Upsilon^l(t) \overset{D_h}{\leqslant} \Upsilon^h(t), \tag{3}$$

where $\leqslant^{D_\theta}$ indicates the preference relation of D_θ. Then,

Proposition 1. In ex post renegotiation, C proposes the menu $M \equiv \{\Upsilon^l(t_d), \Upsilon^h(t_d)\}$, and D_θ accepts $\Upsilon^\theta(t_d)$ if and only if $t_d \in T^*$.

Proof. First note that by definition, D_θ is indifferent between $\Upsilon^\theta(t_d)$ and the status quo at Date 4-2. Moreover, conditions (2) and (3) ensure that D_θ (weakly) prefers $\Upsilon^\theta(t_d)$ to $\Upsilon^{\theta'}(t_d)$. Therefore, if the menu $M \equiv \{\Upsilon^l(t_d), \Upsilon^h(t_d)\}$ is proposed by C, a low-type D will accept $\Upsilon^l(t_d)$ and a high-type D will accept $\Upsilon^h(t_d)$, immediately.

Now consider C's decision to propose a menu at Date 4-1. C prefers both $\Upsilon^l(t_d)$ and $\Upsilon^h(t_d)$ to no deal at Date 4-2. Moreover, Given that $\Upsilon^l(t_d) \in P_l$ is Pareto efficient and it makes D_l just indifferent about accepting the offer, there is no alternative tariff pair that improves C's welfare and induces D_l to accept the proposal immediately. The same argument applies to $\Upsilon^h(t_d)$. Thus, C will propose $M \equiv \{\Upsilon^l(t_d), \Upsilon^h(t_d)\}$ if conditions (2) and (3) are satisfied.

To show that conditions (2) and (3) are also necessary for this outcome, note that if either of these conditions is violated, then the two types will pool by choosing the same tariff from the proposed menu $M \equiv \{\Upsilon^l(t_d), \Upsilon^h(t_d)\}$. QED. ∎

4.2 Interim Renegotiation

I consider the possibility of renegotiation at the interim stage, defined as the time between the (private) realization of the state of world and executing the status quo mechanism (Holmström and Myerson 1983). Similar to Beaudry and Poitevin (1995), I assume that one party has the opportunity to offer an alternative mechanism at this stage. The interim renegotiation problem, therefore, could be thought of as a new mechanism-design problem where each party knows its type and the outside option of the parties is given by the status quo mechanism. This mechanism is restricted by the same constraints as in the main mechanism-design problem, namely, incentive compatibility and renegotiation-proof constraints.

Formally, C proposes an alternative mechanism at date 1-1 (Figure 3). At Date 1-2, D may accept or reject this proposal. If D rejects the proposal, the game proceeds to Date 2 and the status quo mechanism will be executed. If D accepts the proposal, the alternative mechanism will be

Date

0 ——————— D observes its type, θ.

1 ——————— **[Interim Stage]** Interim Renegotiation

1-1 ———— C proposes an alternative agreement.

1-2 ———— D either accepts and executes the alternative agreement

2 ——————— **[Message]** D reports θ_D as its type.

3 ——————— **[Arbitration]**

4 ——————— **[Ex Post Stage]** Ex Post Renegotiation

4-1 ———— C proposes a menu of tariff pairs, M.

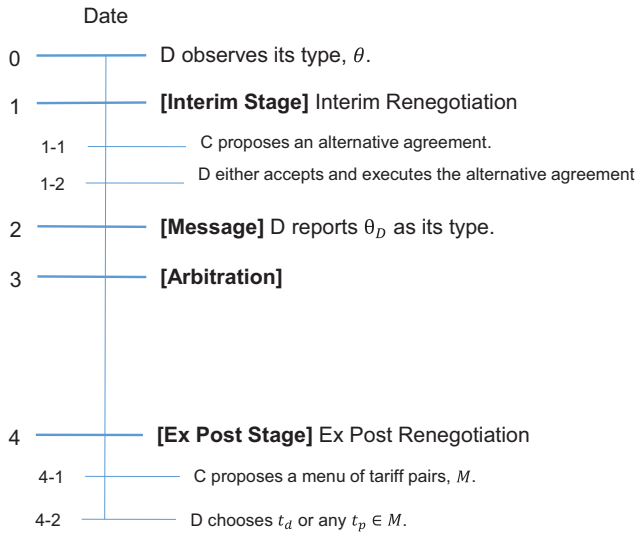4-2 ———— D chooses t_d or any $t_p \in M$.

Figure 3. Timeline of the Interim and Ex Post Renegotiation Stages.

executed. In order to study the outcome of interim renegotiation, we first need to calculate each party's expected welfare from playing out the (status quo) mechanism. In the subsequent sections, the interim renegotiation will be studied as part of the optimal mechanism design problem.

5. The Optimal Direct-Revelation Mechanism

In this section, I study the design of trade agreements as a renegotiation-proof DM.[18] This mechanism will set a useful benchmark for the subsequent sections in which I study the common legal institutions and rules such as the liability rule and the property rule systems.

The complete timeline of the game induced by a DM is depicted in Figure 4. In the messaging stage (Date 2), D directly reports its type. In the arbitration stage, instead of assuming a structure such as the ALR, I assume that the DSB could determine an enforceable outcome as a function of D's report, θ_D, and its own observed signal, θ_A. I, therefore, use $t(\theta_D, \theta_A) \equiv \left(\tau^D(\theta_D, \theta_A), \tau^C(\theta_D, \theta_A)\right)$ to denote a mechanism or decision rule.

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18. Brennan and Watson (2013) show that the possibility of renegotiation amounts to a constraint on the problem. They formalize a "Renegotiation-Proofness Principle" (RPP) and find conditions under which this principle holds. This principle states that any payoff vector that is implementable with renegotiation can also be implemented by a mechanism that is renegotiation proof. However, in general the renegotiation-proofness requirement may preclude some payoff vectors that are implementable. For example, as shown by Brennan and Watson (2013), the RPP fails to hold when renegotiations are costly. I follow a strand of the literature (e.g., Dewatripont 1989) that focuses on renegotiation-proof mechanisms.
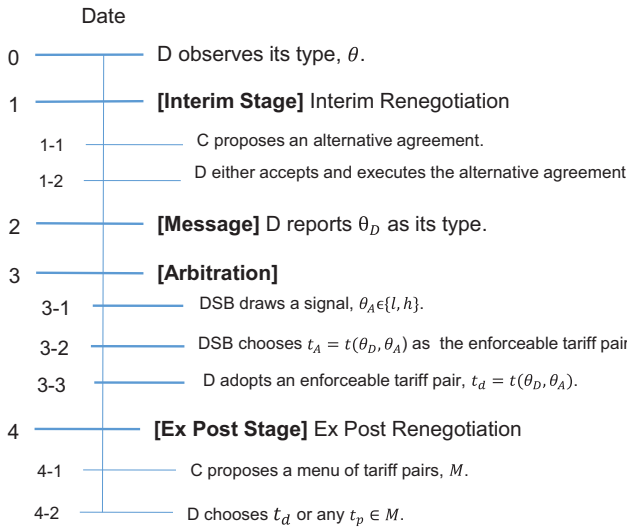
Date

0		D observes its type, θ.
1		**[Interim Stage]** Interim Renegotiation
	1-1	C proposes an alternative agreement.
	1-2	D either accepts and executes the alternative agreement
2		**[Message]** D reports θ_D as its type.
3		**[Arbitration]**
	3-1	DSB draws a signal, $\theta_A \in \{l, h\}$.
	3-2	DSB chooses $t_A = t(\theta_D, \theta_A)$ as the enforceable tariff pair.
	3-3	D adopts an enforceable tariff pair, $t_d = t(\theta_D, \theta_A)$.
4		**[Ex Post Stage]** Ex Post Renegotiation
	4-1	C proposes a menu of tariff pairs, M.
	4-2	D chooses t_d or any $t_p \in M$.

Figure 4. Complete Timeline of the Game Induced by DM.

I assume that the mechanism designer's objective is to maximize the expected joint welfare of the governments defined as $W(t; \theta) \equiv V^D(t; \theta) + V^C(t)$.[19] If a decision rule, $t(\theta_D, \theta_A)$, is implemented, the expected joint welfare of the parties will be given by

$$
\begin{aligned}
EW\Big(t(\theta_D, \theta_A)\Big) \equiv \rho\Big[\gamma W\Big(t(h, h); h\Big) + (1 - \gamma) W\Big(t(h, l); h\Big)\Big] \\
+ (1 - \rho)\Big[\gamma W\Big(t(l, l); l\Big) + (1 - \gamma) W\Big(t(l, h); l\Big)\Big].
\end{aligned}
\tag{4}
$$

Given the focus of the paper on renegotiation-proof mechanisms, we can restrict attention to a subset of tariff pairs that could be part of a renegotiation-proof mechanism. In particular:

Lemma 1. Any $t_d \notin P_l \cup P_h$ will be renegotiated in the ex post stage regardless of the true state of the world. Moreover, $P_l \cup P_h \subset T^*$.

Proof. It is sufficient to show that for any $t_d \notin P_l \cup P_h$, there exist a menu of tariff pairs, all of which are preferred to t_d by C and some of which are (weakly) preferred by D_l and D_h to t_d. The upper envelope of the indifference curves of D_l and D_h that go through t_d is such a menu.

---

19. This assumption is plausible if countries are ex ante symmetric or if governments can transfer side payments at the time of crafting a trade agreement. It is also straightforward to use a weighted joint-welfare. However, since the structure of the optimal agreement is determined by the incentive compatibility constraints, a weighted joint welfare function does not change our qualitative results.

Therefore, $t_d \notin P_l \cup P_h$ will be renegotiated in the ex post stage for any state of the world. It is straightforward to show that any tariff pair in $P_l \cup P_h$ satisfies conditions (2) and (3). Hence, $P_l \cup P_h \subset T^*$.   ■

This lemma implies that a truthful mechanism is impervious to renegotiation only if

$$t(\theta_D, \theta_A) \in P_{\theta_D}, \tag{5}$$

for $\theta_D = l, h$. Therefore, the problem of the optimal renegotiation-proof mechanism may be written as $max_{t(\theta_D, \theta_A)} EW\Big(t(\theta_D, \theta_A)\Big)$, subject to equation (5), and incentive compatibility conditions. For the low-type D, the incentive compatibility condition may be written as

$$
\begin{aligned}
&\gamma V^D\Big(t(l, l); l\Big) + (1 - \gamma)V^D\Big(t(l, h); l\Big) \\
&\geq \gamma V^D\Big(\Upsilon^l\big(t(h, l)\big); l\Big) + (1 - \gamma)V^D\Big(\Upsilon^l\big(t(h, h)\big); l\Big).
\end{aligned}
\tag{6}
$$

The left- (right-)hand side of equation (6) indicates the expected welfare of the low-type D if the state of the world is reported truthfully (untruthfully). To understand the expression on the right-hand side, note that if D_l misrepresents its type by announcing $\theta_D = h$, the outcome of the mechanism, $t(h, \theta_A)$, will not be Pareto efficient, in which case the outcome is renegotiated to $\Upsilon^l\Big(t(h, \theta_A)\Big)$ for $\theta_A = l, h$. The incentive compatibility condition for D_h may be obtained in a similar way, which yields

$$
\begin{aligned}
&\gamma V^D\Big(\Upsilon^h\big(t(h, h)\big); h\Big) + (1 - \gamma)V^D\Big(\Upsilon^h\big(t(h, l)\big); h\Big) \\
&\geq \gamma V^D\Big(\Upsilon^h\big(t(l, h)\big); h\Big) + (1 - \gamma)V^D\Big(\Upsilon^h\big(t(l, l)\big); h\Big).
\end{aligned}
\tag{7}
$$

Letting DM denote the mechanism that maximizes equation (4) subject to the incentive compatibility and renegotiation proof constraints (5)–(7), we have

Lemma 2.   DM is robust to interim renegotiation.

This Lemma states that regardless of the realized state of the world, at the interim stage the parties could not find an alternative mechanism that is jointly preferred to DM. A complete proof of this lemma is provided in Appendix B. To obtain an initial understanding of this result, note that the mechanism design problem faces essentially the same constraints in the interim and ex ante stages. The only difference is that D knows his type at the interim stage but not ex ante. But, C's information about the state of the world at the interim stage will be identical to her prior at the ex ante stage. This makes it impossible to come up with an alternative mechanism that is preferred by both parties under some states of the world.

Letting $t_{\text{DM}}(\theta_D, \theta_A)$ denote the outcome of DM as a function of θ_D and θ_A, the following proposition establishes the properties of the optimal renegotiation-proof DM:

Proposition 2. The outcome of the optimal renegotiation-proof DM satisfies the following conditions:

- (i) $t_{DM}(l, l) = t_{DM}(l, h) \equiv t_{DM}(l, .) \in P_l$.
- (ii) $t_{DM}(h, h), t_{DM}(h, l) \in P_h$, $\tau^D_{DM}(h, h) > \tau^D_{DM}(h, l)$, $\tau^C_{DM}(h, h) < \tau^C_{DM}(h, l)$.
- (iii) A low-type defending country is indifferent about truthfully revealing its type, that is, condition (6) is satisfied with equality.

To elaborate, the outcome of this DM is one of three tariff pairs, $t_{DM}(l, .)$, $t_{DM}(h, h)$, and $t_{DM}(h, l)$, which is depicted in Figure 5. If the importing country announces $\theta_D = l$, the tariff pair $t_{DM}(l, .) \in P_l$ will be implemented. If $\theta_D = h$ is announced, the outcome is either $t_{DM}(h, h)$ or $t_{DM}(h, l)$ depending on the signal received by the arbitrator. The importing country prefers $t_{DM}(h, h)$ to $t_{DM}(h, l)$ while the exporting country has the opposite preference.

Part (i) of this proposition implies that under the optimal mechanism, the DSB's signal will be redundant when the importing country reports a low political-economy pressure. To obtain an intuition for this result, note that the parties' joint welfare indicates risk aversion. Thus, other things equal, a certain outcome is preferred to a lottery.[20]

Part (ii) of proposition 2 states that the tariff of D (C) is higher (lower) when the DSB's signal is h rather than l. Part (iii) of the proposition can be stated as

$$V^D\Big(t_{DM}(l, .); l\Big) = \gamma V^D\Big(\Upsilon^l\big(t_{DM}(h, l)\big); l\Big) + (1 - \gamma)V^D\Big(\Upsilon^l\big(t_{DM}(h, h)\big); l\Big). \tag{8}$$

This equality condition implies that the low-type defending country is indifferent between the tariff pair $t_{DM}(l, .)$ and a lottery between $\Upsilon^l\big(t_{DM}(h, l)\big)$ and $\Upsilon^l\big(t_{DM}(h, h)\big)$ with probabilities γ and $1 - \gamma$, respectively.

The benefit of incorporating arbitration in the agreement arises from the fact that a high-type defending country is more likely to receive a favorable policy recommendation than a low-type defending country. This increases the cost to a low-type D of mimicking a high type. To illustrate, consider an extreme case in which the arbitrator's signal is perfect (i.e., $\gamma = 1$). A perfectly informed arbitrator could simply assign the first-best outcome, namely $t_E(l)$ and $t_E(h)$. In the other extreme, an

---

20. Contrary to Part i of this proposition, suppose that $t_{DM}(l, l) \neq t_{DM}(l, h)$ and consider a tariff pair, t', that generates the same payoffs for the low-type D as does the lottery between $t_{DM}(l, l)$ and $t_{DM}(l, h)$. Replacing $t_{DM}(l, l)$ and $t_{DM}(l, h)$ with t' in the mechanism does not affect incentive compatibility condition, while generates a higher joint welfare.
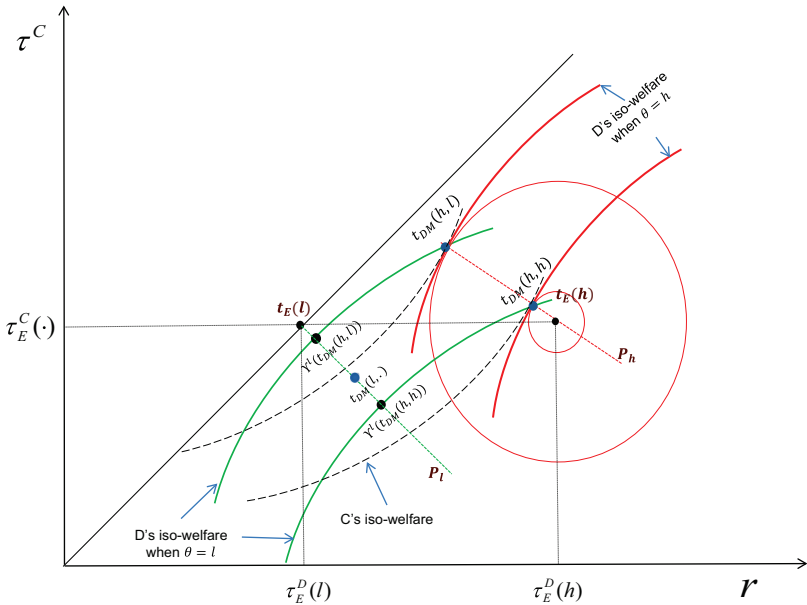
Figure 5. The Optimal *Direct Mechanism*, DM: $t_{DM}(l, .)$, $t_{DM}(h, l)$, and $t_{DM}(h, h)$.

arbitrator with a completely uninformative signal, as in Beshkar (2010a), could be replaced with a purely randomizing device.

6. The Optimal *ALR*

The ALR provides an alternative to the DM that was introduced in Section 5. The two mechanisms are different only in the type of messages sent by the informed party and the set of outcomes that can be recommended and enforced by the arbitrator. These differences may be observed by comparing timelines of the DM and the ALR in Figures 1 and 4. First, under the ALR, the invocation of the escape clause, or lack thereof, is the message that is sent by the informed party at Date 2. That is different from a DM in which *D*'s message is chosen from its type space, $\theta \in \{l, h\}$.

The second difference between the ALR and a DM is the range of outcomes that can be recommended and enforced by the arbitrator. (Compare Date 3 in Figures 1 and 4.) As described in Definition 1, under the ALR, the arbitrator is bound to recommend the tariff binding, τ_b^D, or the safeguard tariff, τ_s^D, and enforce any tariff pair that *D* chooses on the corresponding retaliation scheme.[21]

---

21. In other words, the defending party has the right to choose any tariff, τ^D, above DSB's recommendation, while the DSB limits the magnitude of retaliation from the complaining party to $\tau^C < r_{\theta_A}(\tau^D)$.

My objective in this section is to show that the outcome of the optimal DM may be implemented under the ALR. My approach, therefore, is to choose t_b, t_s, $r_l(\tau^D)$, and $r_h(\tau^D)$ under which the equilibrium of ALR replicates the outcome of the DM. The rest of this section provides the proof of the following proposition:

Proposition 3.   The optimal ALR implements the outcome of the DM. The parameters of the optimal ALR, that is, (t_b, t_s, r_{θ_A}), satisfy the following conditions:

$$t_b = \Upsilon^l\Big(t_{DM}(h, l)\Big), \tag{9}$$

$$\Upsilon^l(t_s) = \Upsilon^l\Big(t_{DM}(h, h)\Big), \tag{10}$$

$$\Upsilon^l\Big(\tau^D, r_{\theta_A}(\tau^D)\Big) = \Upsilon^l\Big(t_{DM}(h, \theta_A)\Big), \forall \tau^D \leqslant \tau^D_{DM}(h, \theta_A), \tag{11}$$

$$V^C\Big(\tau^D, r_{\theta_A}(\tau^D)\Big) = V^C\Big(t_{DM}(h, \theta_A)\Big), \forall \tau^D \geqslant \tau^D_{DM}(h, \theta_A), \tag{12}$$

for $\theta_A \in \{l, h\}$.

In the remainder of the article, I use ALR to refer to the optimal ALR, which satisfies conditions (9)–(12). The mechanism characterized in this proposition is depicted in Figure 6. The tariff binding in this figure satisfies condition (9), that is, $t_b = \Upsilon^l\Big(t_{DM}(h, l)\Big)$.[22] That is, t_b is chosen such that when $\theta = l$, ex post renegotiation from $t_{DM}(h, l)$ lead to t_b.

Similarly, condition (10) implies that the safeguard tariff pair, t_s, is chosen such that when $\theta = l$, renegotiation from t_s and $t_{DM}(h, h)$ lead to the same outcome. Moreover, as required by the definition of the ALR, t_b and t_s in Figure 6 specify the same tariff for C, that is, $\tau^C_s = \tau^C_b$.

Condition (11) requires the retaliation schemes, $r_l(\tau^D)$ and $r_h(\tau^D)$, to be the "*bargaining paths*" that correspond to $t_{DM}(h, l)$ and $t_{DM}(h, h)$, respectively, when $\theta = l$. These retaliation schemes ensure that a low-type D will be in the same bargaining position regardless of the tariff that it chooses above the arbitrator's recommended level.

To clarify further, I discuss each of these retaliation schemes separately. For any τ^D in the $[t_b, \tau^D_{DM}(h, l)]$ interval, $r_l(\tau^D)$ characterizes the set of tariff pairs that would be renegotiated to $t_b = \Upsilon^l\Big(t_{DM}(h, l)\Big)$ in the ex post stage if $\theta = l$. For $\tau^D > \tau^D_{DM}(h, l)$, $r_l(\tau^D)$ authorizes a sufficiently large retaliation that preserves C's payoffs at $t_{DM}(h, l)$, namely:

$$V^C\Big(\tau^D, r_l(\tau^D)\Big) = V^C\Big(t_{DM}(h, l)\Big), \forall \tau^D \geqslant \tau^D_{DM}(h, l). \tag{13}$$

This latter part of the retaliation scheme, which coincides with C's indifference curve that goes through $t_{DM}(h, l)$, ensures that a high-type D will not choose a tariff higher than $\tau^D_{DM}(h, l)$.

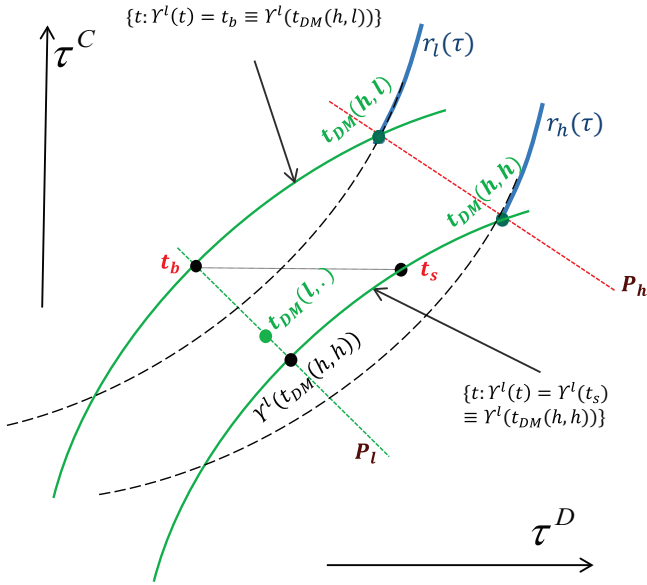22. Recall that $\Upsilon^\theta(t)$ was defined by equation (1).

Figure 6. The Optimal ALR.

The retaliation scheme $r_h(\tau^D)$ has a similar interpretation. In particular, for any $\tau_s^D \leqslant \tau^D \leqslant \tau_{DM}^D(h, h)$, $\left(\tau^D, r_h(\tau^D)\right)$ is a tariff pair that will be renegotiated to $\Upsilon^l\left(t_{DM}(h, h)\right)$ if $\theta = l$. For $\tau^D > \tau_{DM}^D(h, h)$, $\left(\tau^D, r_h(\tau^D)\right)$ is a tariff pair that preserves C's payoffs at $t_{DM}(h, h)$. Finally, note that the safeguard tariff pair, t_s, defined by equation (10), is located on the $r_h(\tau^D)$ schedule.

The above discussion establishes the following result:

Lemma 3. Given arbitrator's judgment, θ_A, the outcome of ex post renegotiation under the ALR is $t_{DM}(h, \theta_A)$ iff $\theta = h$ and $\Upsilon^l\left(t_{DM}(h, \theta_A)\right)$ iff $\theta = l$.

Having characterized the outcome of the game after arbitration, we can now find the equilibrium of the interim renegotiation:

Proposition 4. If the ALR mechanism is in place, C proposes $t_S = t_{DM}$ $(l, .)$ as an alternative agreement in the interim stage, and D will accept (reject) this proposal if $\theta = l$ ($\theta = h$).

Proof. In the interim renegotiation, a low-type D will accept a settlement proposal, t_S, if and only if

$$V^D(t_S; l) \geqslant \gamma V^D(t_b; l) + (1 - \gamma) V^D\left(\Upsilon^l(t_s); l\right). \tag{14}$$

On the other hand, we know from equation (8) that

$$V^D\Big(t_{DM}(l,.);l\Big) = \gamma V^D\Big(\Upsilon^l\big(t_{DM}(h,l)\big);l\Big) + (1-\gamma)V^D\Big(\Upsilon^l\big(t_{DM}(h,h)\big);l\Big).$$
(15)

Therefore, given that $t_b = \Upsilon^l\Big(t_{DM}(h,l)\Big)$ and $\Upsilon^l(t_s) = \Upsilon^l\Big(t_{DM}(h,h)\Big)$ due to equations (9) and (10), $t_S = t_{DM}(l,.)$ will satisfy equation (14) with equality.

Now consider the incentives of a high-type D regarding a proposed tariff pair t_S. A high-type D will accept t_S if and only if

$$V^D(t_S;h) \geqslant \gamma V^D\Big(t_{DM}(h,h);h\Big) + (1-\gamma)V^D\Big(t_{DM}(h,l);h\Big).$$
(16)

However, the incentive compatibility of the DM for the high-type D implies that

$$V^D\Big(t_{DM}(l,.);h\Big) < \gamma V^D\Big(t_{DM}(h,h);h\Big) + (1-\gamma)V^D\Big(t_{DM}(h,l);h\Big).$$
(17)

Therefore, the high-type D will reject the settlement proposal $t_S = t_{DM}(l,.)$.

Finally consider C's incentive to propose $t_S = t_{DM}(l,.)$. Given that this proposal is only accepted by a low-type D, C will be willing to propose such a tariff pair if and only if

$$V^C\Big(t_{DM}(l,.)\Big) > \gamma V^C\Big(\Upsilon^l\big(t_{DM}(h,l)\big)\Big) + (1-\gamma)V^C\Big(\Upsilon^l\big(t_{DM}(h,h)\big)\Big).$$
(18)

If this condition is satisfied, then together with condition (15), it implies that

$$W\Big(t_{DM}(l,.);l\Big) > \gamma W\Big(\Upsilon^l\big(t_{DM}(h,l)\big);l\Big) + (1-\gamma)W\Big(\Upsilon^l\big(t_{DM}(h,h)\big),l\Big).$$

In other words, when $\theta = l$, condition (18) would require that the parties' expected joint welfare be higher under the lottery between $\Upsilon^l\Big(t_{DM}(h,l)\Big)$ and $\Upsilon^l\Big(t_{DM}(h,h)\Big)$ with probabilities γ and $1-\gamma$, respectively, than under $t_{DM}(l,.)$.

Therefore, if $t_S = t_{DM}(l,.)$ in the interim stage of the ALR game, the DM is implemented.

Now suppose that C could propose a mechanism, DM', to D that results in a higher expected payoffs for C than offering $t_S = t_{DM}(l,.)$. Since D has the option to go with DM, D's payoff under DM' should be at least as high as his expected payoffs under DM. Therefore, DM' would be acceptable only if it leads to higher expected joint-welfare than the DM. But this is contrary to the assumption that DM maximizes the expected joint welfare of the parties subject to incentive compatibility and renegotiation proof conditions. ∎

Lemma 3 and Proposition 4 together imply that, as depicted in Figure 6, the outcome of the ALR is one of three tariff pairs, $t_{DM}(l,.)$, $t_{DM}(h,l)$, and $t_{DM}(h,h)$, which replicates the optimal DM. This completes the proof of Proposition 3.

We, therefore, have shown that the optimal DM which does not look "practical", has a simple representation, that is, the ALR, which resembles the customary institutional structure of international organizations.

7. Implications of the ALR

I will now explore different implications of the optimal trade/arbitration agreement that was characterized in the previous sections. I state the results of this section informally as they are intuitive given the formal results that we have obtained so far.

7.1 Depth of Liberalization, Magnitude of Escape, and DSB's Monitoring Quality

Transition from GATT to the WTO included a notable reform in the escape clause. Article XIX of GATT indicates that an exporting country that is affected by a safeguard measure (or escape) could suspend substantially equivalent concessions as a means of receiving compensation. Under the WTO's Agreement on Safeguards, however, the affected exporting countries' right to receive compensation is subject to DSB's authorization. As a result of reforms introduced by the Agreement on Safeguards, an importing country that adopts a safeguard measure is not required to compensate affected countries for a period of four years, unless the DSB rules the adopted safeguards illegal. As described by Pelc (2009), over time "compensation after escape" has been largely replaced with "appeal to exception" in the GATT/WTO.[23]

My model suggests that these reforms in the safeguard rules might have been prompted by an increase in the accuracy of the DSB in monitoring and verifying different trade-related contingencies. As discussed at the end of Section 5, with a fully informed arbitrator, the optimal agreement achieves the first-best outcome. The first-best outcome includes a safeguard clause that allows a relatively large escape from the tariff binding with no compensation requirement. Moreover, under the first-best outcome the parties fully comply with the DSB's ruling and no retaliation will take place. Finally, as the DSB's signal improves, the optimal tariff binding decreases. In summary,

Remark 1.   As DSB's signal improves, the optimal trade agreement features more aggressive trade liberalization (i.e., a lower tariff binding τ_b^D), and a greater magnitude of escape (i.e., a greater $\tau_s^D - \tau_b^D$).[24]

7.2 Early Settlement, Non-Compliance, and DSB's Biased Ruling Pattern

Under the ALR, a dispute will arise if an importing country wants to apply a tariff above the committed binding. The model predicts that

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23. Maggi and Staiger (2015b) interpret this change in the escape rules as an evolution from liability rule (which requires compensation for breach) to property rule (which requires a consensus for modification of concessions).

24. In Maggi and Staiger (2015b), an increase in DSB's signal quality increases the efficiency of a property-rule system over a liability-rule system.

when the political-economy parameter has a low realization, the two par-
ties (i.e., the importer and the exporter) will find a mutually accepted
solution (namely, an early settlement) and arbitration will not be invoked.
The early settlement agreement involves a tariff pair, $t_{DM}(l, .)$, that is more
favorable to the importing country than the tariff binding, t_b. This implies
that under this regime, the exporting country will tolerate small deviations
from the agreement by the importing country. The source of this *forbear-
ance* is the fact that the arbitration system is imperfect and adjudication
may result in a worse situation for the exporting country.[25],[26]

Non-compliance with the DSB's ruling and retaliatory actions also
occur in equilibrium. The model predicts that an importing country that
is under high political-economy pressures will *always* decline to limit its
tariff to the level that is determined by the DSB on the equilibrium path.
However, the level of retaliations that such an importing country will face
depends on the DSB's findings regarding the legitimacy of a contingent
protection measure.

This sharp prediction about non-compliance with the DSB's ruling
could inform the current debate on the rulings of the WTO's DSB since
its inception in 1995. The data on the official rulings of the DSB reveal a
high disparity between the success rates of the complaining and defending
parties. As reported by Colares (2009), the DSB rules against the defend-
ing party in more than 88% of cases where the subject of dispute is related
to trade remedies.[27] In some categories of disputes this disparity is even
more dramatic. For example, in litigations regarding the safeguard meas-
ures adopted to protect domestic industries against potentially harmful
surge in imports, the DSB has always ruled against the defending party
(Sykes 2003).

Some observers have assessed this pro-complainant ruling pattern as
unsatisfactory. For example, Sykes (2003) and Grossman and Sykes
(2007) argue that the DSB's interpretation of the WTO Agreement has
made it increasingly difficult for the governments to resort to the escape
clause, which frustrates the purpose of the WTO Agreement on
Safeguards. Colares (2009) attributes the DSB's bias to the normative
views of the individuals who are involved in the DSB and argues that
the asymmetrical pattern of the DSB's ruling is "the result of a process
of authoritative normative evolution (i.e., rule development) that has ex-
pressed itself with a tilt favoring complainants."

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25. In practice, many safeguard measures are not formally challenged in the WTO. Such
cases may reflect the forbearance predicted by this article.

26. Within a repeated-game framework, Bowen (2011) provides a model in which signa-
tories of a trade agreement show *forbearance,* where one country withholds retaliation when
its trading partner receives a shock. The forbearance under the ALR is different in that the
exporting country forgoes *its right to challenge* the importing country's illegal measure in the
dispute settlement process.

27. For non-trade remedy cases this rate is 83.33%.

The results of this article suggest that an optimally designed WTO would show some bias toward the complainants in the trade disputes.[28] It can be observed from Figure 6 that even if the DSB finds evidence in favor of the defending country, that is, $\theta_A = h$, the defending country will not have a full victory. In such a case, the DSB's optimal ruling is to allow the defending country to escape from the binding, τ_b^D, and adopt the safeguard tariff, τ_s^D, with impunity. But when $\theta = h$, the defending country will violate the ruling of the DSB by setting $\tau^D = \tau_{DM}^D(h, h) > \tau_s^D$. In other words, even if the DSB finds evidence in favor of the defendant, the level of protection adopted by the defending party will exceed the level that is authorized by the DSB.

7.3 The Property Rule

The Property Rule is another important legal principle that is often used to regulate the exchange of entitlements. Under this rule, both parties' consent is required to change the default entitlements. In an international trade cooperation setting, the property rule may be interpreted as allocating the right of market access to each country and letting governments renegotiate those entitlements based on mutual consent.

An important difference between the liability and the property rules, therefore, is that the latter leaves renegotiations unrestricted. In other words, the property rule system is akin to a power-based dispute settlement procedure in which the outcome of negotiation is determined directly by the relative bargaining power of the parties. The analysis of this article, however, shows that when efficient side payments are unavailable, a power-based relationship does not necessarily lead to an efficient outcome. In particular, as was elaborated before, under the optimal escape rule, the exporting country is not compensated fully for its loss. In contrast, under the property rule the affected exporting country would be more-than-compensated for its loss by sharing the rent from increased protection in the importing country. We can, thus, conclude that:

Remark 2. The Property Rule is suboptimal as an escape provision.

Although the property rule is irreconcilable with efficient breach (i.e., escape), it can be part of an optimal mechanism if instead of giving the *right of market access* to the exporting countries, we give the *right of import protection* to the importing countries. In fact, the DM mechanism as depicted in Figure 6 can be immediately interpreted as a Property Rule system in which the DSB's recommended outcome is either $t_{DM}(h, l)$ (when $\theta_A = l$) or $t_{DM}(h, h)$ (when $\theta_A = h$). Just as in DM, any deviation from these recommendations will require both parties' consent. In that case, if $\theta = h$, then the parties will implement the DSB's recommendation (since it

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28. This result, however, does not rule out the possibility that the DSB may be biased too much in favor of the complaining parties, as suggested by Sykes (2003) and Grossman and Sykes (2007).

is Pareto efficient given $\theta = h$), and if $\theta = l$, then ex post renegotiation lead parties to the tariff pair $\Upsilon^l\!\left(t_{DM}(h, \theta_A)\right)$.[29] Therefore,

Remark 3. The optimal agreement under the property-rule regime characterizes higher default tariff commitments than under the liability-rule regime. Moreover, under the property-rule regime, the agreement tariffs are renegotiated down whenever the political-economy parameter in the importing country is low.

In other words, the optimal property rule does not feature an "escape" mechanism. Under the property-rule regime, the parties do not commit to substantial tariff cuts ex ante, but tariff cuts may be negotiated in each period. The actual trade agreements, however, are structured in a starkly different way, such that the default tariffs are set low and parties are given flexibility via an escape clause. Therefore, the structure of an optimal liability-rule system bears a closer resemblance to the structure of the actual international trade institutions. This observation suggests that within the common structure of tariff agreements, the property rule is not the optimal form of remedy.

7.3.1 Comparison with Maggi and Staiger (2015a, 2015b). Under the framework of Maggi and Staiger (2015a, 2015b), when the benefits of protection are relatively small compared with the cost of transfers, the optimal contract is rigid and it does not induce renegotiation in the equilibrium. Maggi and Staiger interpret this contract form as the property rule or, equivalently, a liability rule with a prohibitive compensation requirement.

In my view, it is not instructive to label a system as property rule, or liability rule for that matter, when no adjustment of obligations takes place in equilibrium. That is because these legal notions have been developed to analyze the exchange of entitlements or modification of contractual obligations, not to describe a rigid contract.

In contrast, under the framework of the current paper, the property rule induces renegotiation in equilibrium (Remark 3). The optimal contract under the property rule features high tariff binding that is negotiated down under states of the world where bilateral liberalization is Pareto improving. In contrast, the optimal contract under the liability rule features a low tariff binding with the possibility of escape.

The model of this article differs from that of Maggi and Staiger in three major ways. The first difference is in the type of transfer mechanisms that is assumed in these models. Without modeling the transfer mechanism explicitly, Maggi and Staiger assume that transferring welfare among

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29. To be concrete, consider the game that is induced by the property-rule regime that I just described. In the interim stage, that is, after the realization of the state of the world but before playing the mechanism, the parties can negotiate a settlement to avoid arbitration. This game is identical to the game induced by the ALR. Therefore, as was shown in Proposition 3, DM is implementable as a Perfect Bayesian Equilibrium of this game.

governments involves a transaction cost. In contrast, in my model welfare is transferred through tariff adjustments. An important difference between these two transfer mechanisms is that transfers are always inefficient in Maggi and Staiger, while in this article transfers might be positive- or negative-sum.[30]

A second difference is that trade policy is assumed to be continuous in this article, while the model of Maggi and Staiger hinges on the assumption that trade policy is discrete in nature. More specifically, Maggi and Staiger assume that trade policy is a binary choice between free trade and protection.

A third way in which this article is different from Maggi and Staiger is the assumption of asymmetric information in this article in contrast to symmetric information in Maggi and Staiger. In fact, while asymmetric information is the cause of breakdown in negotiations in this article, in Maggi and Staiger a breakdown in settlement negotiation is due to non-convexity of the payoff frontier.[31]

Finally note that, as long as transfers are made through tariff adjustments, discretizing trade policy in the current paper does not change the general insights that are obtained from the continuous model. Therefore, we can conclude that the main assumption that lead to different results in the two papers is the types of transfer mechanisms that are assumed.[32]

8. Conclusion

This article studies the optimal trade agreement in the presence of private information about political-economy motivations. In this setting, the agreement takes a simple form that resembles a safeguard arrangement with a compensation mechanism: a tariff binding, a safeguard tariff that must be approved by the DSB, and a retaliation scheme that determines the size of retaliations in case of noncompliance. It was shown that the optimal ruling by the DSB demonstrates a bias in favor of the complaining (i.e., exporting) country, such that in any dispute between the parties, the DSB should rule at least partly against the proposed increase in trade protection by the defending country.

The model of this article provides a sharp prediction regarding the pattern of early settlement, litigation, and non-compliance with DSB rulings, such that on the equilibrium path we will always observe non-compliance with the DSB ruling if the early settlement negotiation fails.

Richer results may be obtained by extending this model to capture a more complicated informational structure. For example, the analysis in this article was simplified by ruling out the possibility that the uninformed disputing party may receive a noisy signal of the true state of the world. In practice,

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30. To be sure, note that a tariff reduction as a way of compensating a foreign country is efficiency improving.

31. Nonconvexity in payoff frontier is a direct result of assuming discrete policies.

32. Note, however, that discontinuity of trade policy is a critical assumption for the results obtained in Maggi and Staiger (2015a, 2015b).

however, the disputing parties may have better knowledge and cheaper ways to acquire information about the prevailing state of the world than the arbitrators. The proposed model can be extended by allowing for private signaling, in which the uninformed parties could privately observe a noisy signal about the prevailing state of the world during the pre-arbitration negotiation.

I modeled tariffs as "public actions" that are externally enforced. Although modeling verifiable actions as public actions has been a common practice in the mechanism design literature, Watson (2007) and Buzard and Watson (2012) show that there are important reasons to be cautious about this "*simplifying*" assumption in some economic applications. In particular, if the opportunity to take an action is nondurable in a hold-up problem, assuming that a central planner could choose these actions is not a reasonable characterization of the real world. Moreover, such an assumption is not innocuous as it changes the set of implementable value functions. Modeling tariffs as "individual actions" could be illuminating since the negative economic impact of tariff increases may not be completely eliminated by the promise of future refunds.[33]

Another important area for future research is to consider countries that are asymmetric in technological or political-economy parameters. Such an extension of the model would be particularly useful in understanding whether all types of countries should be equal before the WTO law or whether it is optimal to apply different standards for various types of countries, such as smaller developing countries.

The application of this model is not limited to the DSB. This article may be applied to the analysis of any third-party arbitrator with informative insights about the dispute. For example, experts from World Health Organization and International Monetary Fund can play a useful role in the arbitration process in cases related to health and exchange rate policy, respectively.[34]

Funding

Appendix A. Construction of the Welfare Functions
Markets

Consider a pair of distinct goods m and x with demand functions in the home country (no *) and the foreign country (*) given by

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33. In the case of Generalized System of Preferences in the United States, Hakobyan (2013) provides evidence that a tariff increase has a negative impact on trade volume even when there is an expectation that such tariffs will be refunded in the future.

34. I am grateful to Helen Milner for pointing this out to me.

$$D_m(p_m) = 1 - p_m, \quad D_x(p_x) = 1 - p_x,$$
$$D_m^*(p_m^*) = 1 - p_m^*, \quad D_x^*(p_x^*) = 1 - p_x^*, \tag{19}$$

where p (with the appropriate index) represents the price of a good in a certain country. Specific import tariffs, τ^D and τ^C, that are chosen by countries as the only trade policy instrument, create a gap between domestic and foreign prices. In particular, $p_m = p_m^* + \tau^D$ and $p_x = p_x^* - \tau^C$.

Both countries produce both goods using the following supply functions:

$$Q_m(p_m) = p_m, \quad Q_x(p_x) = bp_x,$$
$$Q_m^*(p_m^*) = bp_m^*, \quad Q_x^*(p_x^*) = p_x^*. \tag{20}$$

Assuming $b > 1$, the home country will be a natural importer of m and a natural exporter of x.

World market clearing condition for good m is $D_m(p_m) + D_m^*(p_m - \tau^D) = Q_m(p_m) + Q_m^*(p_m - \tau^D)$. Substituting for the supply and demand functions from equations (19) and (20), the market clearing condition can be rewritten as $2 - 2p_m + \tau^D = p_m + b(p_m - \tau^D)$. Solving for p_m yields $p_m = \frac{2 + (1 + b)\tau^D}{3 + b}$. Similarly, using the world market clearing condition for good x, the home market price for good x can be calculated; $p_x = \frac{2(1 - \tau^C)}{3 + b}$.

Components of Welfare

Under this model, the market-clearing price of $m(x)$ depends only on the home (foreign) tariff. Let $p_m(\tau^D)$ and $p_x(\tau^C)$, respectively, denote the equilibrium prices of m and x in the home country. If import tariffs are non-prohibitive (i.e., if they are sufficiently small) trade occurs between the countries and the home consumers' surplus from the consumption of m and x will be given, respectively, by

$$\psi_m(\tau^D) \equiv \int_{p_m(\tau^D)}^1 D_m(u)\mathrm{d}u = \frac{1}{2} - p_m + \frac{1}{2}p_m^2 = \frac{1}{2}\left(\frac{(1 + b)(1 - \tau^D)}{3 + b}\right)^2,$$

$$\psi_x(\tau^C) \equiv \int_{p_x(\tau^C)}^1 D_x(u)\mathrm{d}u = \frac{1}{2}\left(\frac{1 + b + 2r}{3 + b}\right)^2.$$

Moreover, the home producers' surplus from the sale of m and x will be given by

$$\pi_m(\tau^D) \equiv \int_0^{p_m(\tau^D)} Q_m(u)\mathrm{d}u = \frac{1}{2}p_m^2 = \frac{1}{2}\left(\frac{2 + (1 + b)\tau^D}{3 + b}\right)^2,$$

$$\pi_x(\tau^C) \equiv \int_0^{p_x(\tau^C)} Q_x(u)\mathrm{d}u = \frac{1}{2}bp_x^2 = 2b\left(\frac{1 - \tau^C}{3 + b}\right)^2.$$

The government's tariff revenue is given by

$$R(\tau^D) \equiv \tau M_m\Big(p_m(\tau^D)\Big) = \frac{(b-1)\tau^D - 2(1+b)\tau^D}{3+b}.$$

where $D_m(p_m)$, the import demand for good m in the home country, is given by

$$D_m(p_m) \equiv D_m(p_m) - Q_m(p_m) = 1 - 2p_m = \frac{b - 1 - 2(1+b)\tau^D}{3+b}.$$

Politically weighted welfare from the importing sector in home country is given by

$$u(\tau^D; \theta) \equiv \psi_m(\tau^D) + \theta\pi_m(\tau^D) + R(\tau^D)$$

$$= \frac{1}{(3+b)^2}\left\{ \begin{array}{l} \frac{1}{2}(1+b)^2 + 2\theta + [2\theta(1+b) - 4]\tau^D \\ + \left[\frac{1+\theta}{2}(1+b)^2 - 2(3+b)(1+b)\right]\tau^D \end{array} \right\}. \quad (21)$$

The home government's welfare from the exporting sector is a function of foreign tariff, τ^D:

$$v(\tau^D) \equiv \psi_x(\tau^D) + \pi_x(\tau^D)$$

$$= \frac{1}{(3+b)^2}\left\{ \frac{(1+b)^2}{2} + 2b + 2(1-b)\tau^D + 2(1+b)(\tau^D)^2 \right\}. \quad (22)$$

Now using the functions u and v constructed above, we can define welfare of the defending (D) and complaining (C) countries. Letting τ^D and τ^C denote the tariffs of D and C, respectively, the welfare functions of the governments are

$$V^D(t; \theta) \equiv u^D(\tau^D; \theta) + v^D(\tau^C),$$

$$V^C(t) \equiv u^C(\tau^C; l) + v^C(\tau^D).$$

Note that given the symmetry of payoff functions in the two countries, we can drop the country subscripts from u and v functions.

Appendix B. Proofs

Lemma 4. For any $\alpha \in (0, 1)$ and $\tau_1^D, \tau_2^D, \tau_3^D < \tau^D(\theta)$, if $u(\tau_3^D; \theta) = \alpha u(\tau_1^D; \theta) + (1-\alpha)u(\tau_2^D; \theta)$, then $v(\tau_3^D) > \alpha v(\tau_1^D) + (1-\alpha)v(\tau_2^D)$.

Proof. As shown in equations (21) and (22), u and v are quadratic functions that may be written as

$$u(\tau^D; \theta) = -A(\tau^D)^2 + B\tau^D + F,$$

$$v(\tau^D) = C(\tau^D)^2 - D\tau^D + G,$$

where

$$A > C > 0, B > D > 0, AD - BC > 0. \quad (23)$$

The first set of inequalities follows since the importer's and the joint welfare functions are concave and the exporter's welfare is convex. The second set of inequalities is satisfied because the importer's and the joint welfare functions are increasing in τ^D for $\tau^D \to 0$ and the exporter's welfare is decreasing in τ^D. The last inequality is satisfied since $\tau^D = \frac{B}{2A}$, $\tau^D = \frac{B-D}{2(A-C)}$, and $t_N(\theta) > t_E(\theta)$.

Given this formulation, the Arrow–Pratt measure of risk aversion for u and $-v$ are, respectively, given by

$$-\frac{u''(\tau^D; \theta)}{u'(\tau^D; \theta)} = -\frac{-2A}{-2A\tau + B},$$

and

$$-\frac{v''(\tau^D)}{v'(\tau^D)} = -\frac{-2C}{-2C\tau + D},$$

According to the Arrow–Pratt theorem, since u and $-v$ are concave, if $-\frac{u''(\tau^D;\theta)}{u'(\tau^D;\theta)} > -\frac{v''(\tau^D)}{v'(\tau^D)}$ then the certainty equivalent of u is always smaller than the certainty equivalent of $-v$ for any probability distribution of τ^D. Therefore, to prove the lemma, it is sufficient to show that $-\frac{u''(\tau^D;\theta)}{u'(\tau^D;\theta)} > -\frac{v''(\tau^D)}{v'(\tau^D)}$, or

$$-\frac{-2A}{-2A\tau + B} > -\frac{-2C}{-2C\tau + D}$$

$$\Leftrightarrow \frac{A}{-2A\tau + B} > \frac{C}{-2C\tau + D}.$$

For $\tau^D < \tau^D$ we have $-2A\tau + B > 0$ and $-2C\tau + D > 0$, thus $-\frac{u''(\tau^D;\theta)}{u'(\tau^D;\theta)} < -\frac{v''(\tau^D)}{v'(\tau^D)}$ iff

$$A(-2C\tau + D) > C(-2A\tau + B),$$

or iff

$$AD - BC > 0.$$

The last inequality is satisfied according to equation (23). QED ∎

Lemma 5. For any t_1, $t_2 \in P_\theta$ and $\alpha \in (0, 1)$, there exists $t_3 \in P_\theta$ such that

$$V^D(t_3; \theta) = \alpha V^D(t_1; \theta) + (1 - \alpha)V^D(t_2; \theta), \qquad (24)$$

and

$$V^C(t_3) > \alpha V^C(t_1) + (1 - \alpha)V^C(t_2). \qquad (25)$$

Proof. Since $t_1, t_2 \in P_\theta$ and $t_1 \neq t_2$, we must have $\tau_1^D \neq \tau_2^D$ and $\tau_1^C \neq \tau_2^C$. Then, according to Lemma 4, there must exist τ^D and τ^C such that

$$u(\tau^D, \theta) = \alpha u(\tau_1^D; \theta) + (1 - \alpha)u(\tau_2^D; \theta), \tag{26}$$

$$v(\tau^D) > \alpha v(\tau_1^D) + (1 - \alpha)v(\tau_2^D). \tag{27}$$

and

$$u(\tau^C, l) = \alpha u(\tau_1^C; l) + (1 - \alpha)u(\tau_2^C; l), \tag{28}$$

$$v(\tau^C) > \alpha v(\tau_1^C) + (1 - \alpha)v(\tau_2^C). \tag{29}$$

Relationships (26) and (29) imply that

$$V^D(t', \theta) > \alpha V^D(t_1; \theta) + (1 - \alpha)V^D(t_2; \theta), \tag{30}$$

Similarly, relationships (27) and (28) imply that

$$V^C(t') > \alpha V^C(t_1) + (1 - \alpha)V^C(t_2). \tag{31}$$

If $t' \notin P_\theta$, then there must exist $t'' \in P_\theta$ such that $V^D(t'', \theta) > V^D(t', \theta)$, and $V^C(t'') > V^C(t')$. Therefore, conditions (30) and (31) imply

$$V^D(t'', \theta) > \alpha V^D(t_1; \theta) + (1 - \alpha)V^D(t_2; \theta), \tag{32}$$

and

$$V^C(t'') > \alpha V^C(t_1) + (1 - \alpha)V^C(t_2). \tag{33}$$

Now defining t_3 such that $t_3 \in P_\theta$ and

$$V(t_3, \theta) = \alpha V^D(t_1; \theta) + (1 - \alpha)V^D(t_2; \theta), \tag{34}$$

Condition (32) implies that $V^D(t_3, \theta) < V^D(t'', \theta)$. Then, since $t'', t_3 \in P_\theta$, we must have

$$\tau^D < \tau_3^D \text{ and } \tau^C > \tau_3^C,$$

which in turn implies that

$$V^C(t_3) > V^C(t''). \tag{35}$$

Therefore, $t_3 \in P_\theta$ satisfies Conditions (24) and (25). QED. ∎

Proof of Proposition 2. Part (ii) Lemma 1 implies that a truthful mechanism is impervious to renegotiation only if $t_{DM}(\theta_D, \theta_A) \in P_{\theta_D}$. Obviously, the outcome of the mechanism is more (less) favorable to D_h (C) when $\theta_A = h$ rather than $\theta_A = l$ (i.e., the defending country is better off if the arbitrator finds a high state of the world). Therefore, since $t_{DM}(h, \theta_A) \in P_h$, we must have $\tau_{DM}^D(h, h) > \tau_{DM}^D(h, l)$, $\tau_{DM}^C(h, h) < \tau_{DM}^C(h, l)$.

Parts (i) To show that $t_{DM}(l, l) = t_{DM}(l, h)$, suppose, on the contrary, that $t_{DM}(l, l) \neq t_{DM}(l, h)$. Then according to Lemma 5, since $t_{DM}(l, h), t_{DM}(l, l) \in P_l$, there exists $t' \in P_l$ such that

$$V^D(t', l) = \gamma V^D\Big(t_{DM}(l, l); l\Big) + (1 - \gamma)V^D\Big(t_{DM}(l, h); l\Big), \qquad (36)$$

and

$$V^C(t') > \gamma V^C\Big(t_{DM}(l, l)\Big) + (1 - \gamma)V^C\Big(t_{DM}(l, h)\Big). \qquad (37)$$

To prove $t_{DM}(l, l) = t_{DM}(l, h) \equiv t_{DM}(l, .)$, it is sufficient to show that the mechanism that is obtained by replacing $t_{DM}(l, h)$ and $t_{DM}(l, l)$ with t' satisfies the incentive compatibility conditions and generates a higher expected joint payoff than that of the DM (hence, the contradiction).

First note that condition (37) implies that C prefers t' to playing DM. Moreover, given equation (36), replacing $t_{DM}(l, h)$ and $t_{DM}(l, l)$ with t' will not impact the welfare of the low-type defending country regardless of its announcement. Therefore, the incentive compatibility condition (6) will be still satisfied if we replace $t_{DM}(l, h)$ and $t_{DM}(l, l)$ with t'. Finally, the incentive compatibility condition of the high-type D (i.e., condition (7)) may or may not be satisfied. In either case the expected joint welfare under this alternative mechanism exceeds that of DM. This is a contradiction as DM is optimal. Thus, $t_{DM}(l, l) = t_{DM}(l, h)$.

Part (iii) By way of contradiction, suppose that the incentive compatibility condition for a low-type D (i.e., condition (6)) is not binding. This means that $t_{DM}(h, h)$ and $t_{DM}(h, l)$ could be shifted further toward $t^E(h)$ without upsetting this condition (see Figure 5). Such an adjustment in $t_{DM}(h, h)$ and $t_{DM}(h, l)$ will increase the joint welfare of the parties when $\theta = h$, while it has no impact on the welfare when $\theta = l$. Thus, the expected joint welfare could be improved if condition (6) is not binding. ∎

Proof of Lemma 2. Consider C's problem of offering an alternative mechanism at Date 1-1 when the current (status quo) mechanism is DM. Note that although D has realized its type at this point, C's information about the state of the world is identical to his information at the ex ante stage (i.e., before Date 0).

The DM may be renegotiated successfully only if there is an alternative mechanism that is incentive compatible and renegotiation proof and weakly preferred by both parties. To prove that there is no such alternative to DM at the interim stage, I follow Holmström and Myerson 's (1983) approach by considering the possibility that both parties would prefer an alternative mechanism under each (private) realization of the state of the world.

Consider an alternative agreement denoted by

$$\mathrm{DM}' \equiv \Big(t_{\mathrm{DM}'}(l, l),\, t_{\mathrm{DM}'}(l, h),\, t_{\mathrm{DM}'}(h, l),\, t_{\mathrm{DM}'}(h, h) \Big).$$

There is a positive chance that this alternative agreement is accepted unanimously if and only if one of the following three cases is possible:

Case 1. The alternative agreement increases the expected payoffs of every type of every player. This is impossible because it simply means that the status quo mechanism (i.e., the DM) is not optimal.

Case 2. Only the high-type D and C vote for mechanism DM'. This case prevails if the following four conditions are satisfied:

(1) The high-type D prefers DM' to DM:

$$\gamma V^D \Big(t_{DM'}(h, h); h \Big) + (1 - \gamma) V^D \Big(t_{DM'}(h, l); h \Big) \tag{38}$$

$$\geqslant \gamma V^D \Big(t_{DM}(h, h); h \Big) + (1 - \gamma) V^D \Big(t_{DM}(h, l); h \Big). \tag{39}$$

(2) The low-type D prefers DM to DM' if it reveals its type truthfully under DM':

$$\gamma V^D \Big(t_{DM'}(l, l); l \Big) + (1 - \gamma) V^D \Big(t_{DM'}(l, h); l \Big) \leqslant V^D \Big(t_{DM}(l, .); l \Big). \tag{40}$$

(3) The low-type D prefers DM to DM' if it reveals its type untruthfully under DM':

$$\gamma V^D \Big(t_{DM'}(h, l); l \Big) + (1 - \gamma) V^D \Big(t_{DM'}(h, h); l \Big) \leqslant V^D \Big(t_{DM}(l, .); l \Big). \tag{41}$$

C prefers DM' to DM assuming that the low-type D rejects DM':

$$\begin{aligned}
\gamma V^C \Big(t_{DM'}(h, h) \Big) + (1 - \gamma) V^C \Big(t_{DM'}(h, l) \Big) \\
> \gamma V^C \Big(t_{DM}(h, h) \Big) + (1 - \gamma) V^C \Big(t_{DM}(h, l) \Big).
\end{aligned} \tag{42}$$

Suppose that DM' satisfies these conditions. Now consider a mechanism, DM'', where $t_{DM''}(l, l) = t_{DM''}(l, h) \equiv t_{DM}(l, .)$, $t_{DM''}(h, l) \equiv t_{DM'}(h, l)$, and $t_{DM''}(h, h) \equiv t_{DM'}(h, h)$. This mechanism is incentive compatible (i.e., a low-type D reveals its type truthfully) due to equation (40). Moreover, conditions (38) and (42) imply that DM'' result in a higher ex ante

expected joint welfare than DM. But this is contrary to the fact that DM is optimal.

Case 3. Only the low-type D and C prefer mechanism DM'. This case prevails iff the following four conditions are satisfied:

The low-type D prefers DM' to DM:

$$\gamma V^D\Big(t_{DM'}(l,l);l\Big) + (1-\gamma)V^D\Big(t_{DM'}(l,h);l\Big) \geqslant V^D\Big(t_{DM}(l,.);l\Big). \quad (43)$$

The high-type D prefers DM to DM':

$$\begin{aligned}
&\gamma V^D\Big(t_{DM'}(h,h);h\Big) + (1-\gamma)V^D\Big(t_{DM'}(h,l);h\Big) \\
&\leqslant \gamma V^D\Big(t_{DM}(h,h);h\Big) + (1-\gamma)V^D\Big(t_{DM}(h,l);h\Big).
\end{aligned} \quad (44)$$

C prefers DM' to DM given that the low-type D, and only the low-type D, will approve DM' :

$$\gamma V^C\Big(t_{DM'}(l,l)\Big) + (1-\gamma)V^C\Big(t_{DM'}(l,h)\Big) \geqslant V^C\Big(t_{DM}(l,.)\Big). \quad (45)$$

Lemma 5 implies that for any $t_{DM'}(l,l)$ and $t_{DM'}(l,h) \in P_l$ there exists t'_l $\in P_l$ such that $\gamma V^D\Big(t_{DM'}(l,l);l\Big) + (1-\gamma)V^D\Big(t_{DM'}(l,h);l\Big) = V^D(t'_l;l)$ and $V^C(t'_l) > \gamma V^C\Big(t_{DM'}(l,l)\Big) + (1-\gamma)V^C\Big(t_{DM'}(l,h)\Big)$. But since $t_{DM}(l,.)$ $\in P_l$ there can exist no t'_l that is preferred to $t_{DM}(l,.)$ by both parties. Therefore, inequalities (43) and (45) cannot be satisfied simultaneously unless $t_{DM'}(l,l) = t_{DM'}(l,h) = t_{DM}(l,.)$.

Therefore, since there is no alternative incentive compatible and renegotiation proof mechanism that is preferred at least weakly by both parties, DM will be impervious to interim renegotiation. ∎

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